Internet of Health
Apps, Wearables, Population Health, and Integrated Care

Jeremy Nelson, CEO Afia Inc.
At a high level

1. New generation of **connected devices**
2. New **models for care delivery**
3. New class of **innovative startups**
4. Supported by **payment reform**
2010 Sensors & Technology

- GPS
- Cameras
- Microphones
- 6-axis accelerometer
- Compass
- Light sensor
- Proximity sensor
- Wi-Fi & 3G
- Bluetooth
In Just The Last 7 Years
2015 Sensors & Technology

- 70x faster CPU
- 90x faster graphics
- NFC
- Barometer
- 4G/LTE
- Bluetooth Low Energy
- Motion Coprocessor
- 3D Touch
“What is your most important device?”

Source: Ofcom Technology Tracker, Data from Q1
Base: All adults aged 16+ who use the internet at home or elsewhere
QE11(QE40): Which is the most important device you use to connect to the internet, at home or elsewhere? ‘Other’ includes: ‘netbook’, ‘games console’, ‘other device’, ‘none’ and ‘don’t know’. Ranked by 2015
Smartphones Are Taking Over
U.S. smartphone user forecast

Source: eMarketer
Smart Devices 1.0
The Pavlok Band

- Activity tracking
- Sleep tracking
- “Shock circuit”
The Pavlok Band

“Pay a fine, lose access to your phone, even get an electric shock... at the hands of your friends” if you fail to meet goals.
Who tracks their health?

- 45% of U.S. adults live with at least one chronic condition.
- Of those with 2+ Conditions
  - 78% have high blood pressure
  - 45% have diabetes

Source: Pew Research
Connected Wearables

Show of Hands
Apple Watch
Common Sensors

- Heart rate sensor
- Accelerometer
- BTLE + Wifi
- GPS (Phone)
Apple S1 Chip
Fourteen Months In

- Battery life - good
- Hardware design - excellent
- Messaging - excellent
- Activity tracking & fitness - good
- Third-party apps - poor
Epic - MyChart on Apple Watch

Appointment reminders, messages, medications integrated with EHR
Emotiv Insight

- Consumer EEG & inertial sensor
- Bluetooth integration with smartphone
- Available via API
Spire Mind & Body Tracker

- Measures breathing & provides feedback
- Senses stress/tension, suggest deep breath
- Included iOS guides “mini-meditations”
MIT “Band-aid of the Future”

- Sticky, stretchy, gel-like material
- Incorporates sensors (e.g., temp to check for infection)
- Lights indicate status/med needs
New Models for Care Delivery
Center For Primary Care And Wellness
Select which Apps you would like to try. Click Send when you are done.

The Apps you choose will be e-mailed to you. Remember to open the e-mail with the device you wish to install the Apps.

<table>
<thead>
<tr>
<th>App Name</th>
<th>IOS App Store</th>
<th>Google Play Store</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pocket First Aid &amp; CPR</td>
<td>$1.99</td>
<td>$1.99</td>
</tr>
<tr>
<td>Symple - Symptom Tracker</td>
<td>$1.99</td>
<td></td>
</tr>
<tr>
<td>KidsDoc</td>
<td>$1.99</td>
<td>$1.99</td>
</tr>
<tr>
<td>Sleep Cycle</td>
<td>$1.99</td>
<td>$1.69</td>
</tr>
</tbody>
</table>

Patient

Visit the Bar to get your apps & devices today!

Your prescription for good health.

**Rx APPS**
- Nutrition
- Fitness
- Women’s
- Oncology
- Diabetes
- Medication
- Smoking
- General Health

**DEVICES**
- Activity Monitor
- Blood Glucose Monitor with Bluetooth
- Wireless Scale
- Wireless Blood Pressure Monitor

Physician Signature

"Tell me and I forget. Teach me and I may remember. Involve me and I learn."

— BEN FRANKLIN
Ochsner Hypertension Pilot

Patients required to have BP readings outside of 140/90

Enrollees are given Apple Watch (must provide their own iPhone)

Clinicians ask patients to obtain a blood pressure cuff

Apple Watch allows patients to receive medication reminders & clinician feedback
Ochsner Hypertension Success

Over 500 patients in pilot

Under Control

- 30 days - 50%
- 60 days - 57%
- 90 days - 62%
King’s College - Chemotherapy

Watch provided to patients

Real-time one-touch med, symptom & temp tracking

Feedback on drug adherence, regimen updates
The Apple Watch takes your resting heart rate about every minute or so. Houle knew there was a problem when his resting heart rate was more than double his average.

He went to the hospital, where he learned he had heart, liver and kidney failure, which could have been fatal if not for his watch.

“If my Apple Watch hadn’t shown me it was 145, I would have done nothing about it.”
Here's an interesting example of new medicine relayed by a cardiologist colleague.

A patient requested a consultation for a pacemaker. This was based on information from his Apple watch. He had dizziness, tracked very fast and very slow heart rates on his watch, Googled this, and self-diagnosed sick sinus syndrome. I confirmed this at our visit. He asked me to put in a wireless pacemaker, which was done as an out-patient.
The Age of Wonders

Our Amazing Future
“Invisibles”

- Minimal, simple, intuitive
- Seamlessly integrated into the human body
- Potential for better adoption and engagement
$61M in venture capital raised
Google Contacts

Measures glucose in tears
“Ingestibles”

- Sensors operate within the body
- Often powered by stomach acid
- Diagnose, observe med adherence, monitor symptoms
Proteus Digital Health

$120M funding raised, cleared by FDA
Given Imaging
Data Silos vs Aggregators
Data Silos

- Hardware-specific
- Closed system
- Proprietary protocols
- Must be installed (↓ adoption)
Data Silos (Runkeeper, Withings, Fitbit)
Aggregators (Apple HealthKit/Google Fit)

- Hardware-agnostic
- Open system
- API-Driven (HealthKit, Google Fit)
- Included with OS
“Apple to fix Health app after blood glucose measurement issue”

“Diabetics are being warned that Apple’s Health app is not compatible with some blood glucose measurements, meaning [some users] could see inaccurate readings.” – CNET, October 15, 2014
HealthKit/Epic Integration

- Patient is downloads the MyChart app
- Doctor “prescribes” tracking of certain data points
- EHR notifies doc if data is “abnormal”

“I’m sorry, there was nothing we could do for the patient. We tried our hardest, but they had an iPhone 4S. We can’t get their data.”
Avoiding readmissions of CHF patients by monitoring weights at home via Withings scales

Alert docs and pharmacists when weight goes up (likely water retention) to titrate medication

“O-bar” for support a la Genius Bar
A software framework made specifically for medical research.
Consent Process is Fully Automated
Parkinson’s disease

mPower
University of Rochester
Xuanwu Hospital, Capital Medical University
Sage Bionetworks
Signature
Please sign using your finger on the line below

Use 2 fingers to alternately tap as fast as you can for 20 seconds.

Total Taps
20

Gait and Balance Test
This test measures your gait and balance as you walk and stand still. To complete this test, you’ll need to put your phone in your pocket and connect headphones to follow audio instructions.
Stanford - MyHeart Counts

1. Download the app. Learn about the study. Review consent information.
2. Start following your daily activity with your phone or wearable activity device.
3. Do a walk test and enter labs to see your heart risk. Learn how to improve your heart health.

11,000 Downloads in First 24 Hours
Autism
Duke

EpiWatch
Johns Hopkins

MoleMapper
OHSU
Autism & Beyond
A Study of Young Children’s Mental Health

Who’s Participating
Total Number of Families Enrolled

1,287

Age

- 47%
- 19%
- 18%
- 8%
- 8%

1 year olds 2 year olds 3 year olds 4 year olds

5 year olds

Caregivers

Activities Dashboard Learn Profile

1 year olds 2 year olds 3 year olds 4 year olds

5 year olds

Sit your child on your lap.

Remove pacifiers or other objects that may block your child’s face. We can detect your child’s facial expressions if they’re wearing glasses but not if something is covering their mouth.

Try not to tell your child what to do. We want to see how your child acts on his or her own.
About the Study

This study looks at young children’s emotions and behaviors to better understand and identify risks for developmental and mental health disorders like autism.

You’ll be asked to answer surveys about your family and your child will watch several videos.

Join Study

Already Participating?

How it Works

While your child watches a video on your iPhone, we will record your child’s face to measure emotion.

You can choose to share the video or only the facial expressions.

Join Study

Already Participating?
A New Class of Innovative Startups
Pacifica - Anxiety and Stress Management

● Based on Cognitive Behavioral Therapy & Meditation.
  ○ Mood Tracking
  ○ Relaxation Techniques
  ○ Thought Diary
  ○ Health Tracking
  ○ Daily Goals
  ○ Mood History
PillPack - Medication Reminders

- Prescriptions auto-populated from user demographics
- Taptic reminders for taking pills
- Custom medication schedules ("packs")
Kardia Mobile - ECG band for Apple Watch

- Apple Watch strap to take Electrocardiogram (EKG, ECG)
- Can record voice annotations
- Healthkit integration for longitudinal analysis
Ginger.io

● Used by providers

● Leverages smartphone data for behavioral analytics & alerts

● Enables more timely interventions
Wellframe – Clinical Tracking

- Payer-, provider-, pharma-driven
- Mobile app for health data collection
- Customizable, flexible clinical protocol
**Activity Suggestions**

- **Walk near East Ave**
  - 1083 walks in 240 days. 20 mins of walk everyday.
  - Each walk nearly 4 min.
  - Let us get 20 mins or more walk here today.

- **Small walks each hour near Campus Rd**
  - Nearly 6 hours sedentary everyday.
  - 3 minute walking breaks each hour can give 18 minutes of walk here today.

- **Exercise**
  - health club exercise classes
  - 123 times in 345 days. Daily nearly 63 cal lost.
  - Keep up the good work

- **Walk near Fall Creek Dr**
  - 297 walks in 240 days. 8 mins of walk everyday.
  - Each walk nearly 4 min.
  - Let us get 8 mins or more walk here today.

---

**Progress**

- **Walk near East Ave**

**Explore more suggestions**

- **MyBehavior**
  - Developed at Cornell

- 1082 times in 240 days. Each walk nearly 4 minutes.

- Continue or walk bit more here.
  - Walking faster could be an option.

- If you just continue your walking habit then you will loose 80 calories.
317 times in 250 days. Each walk nearly 4 minutes.

- Continue or walk bit more here.
- Walking faster could be an option.
- If you just continue your walking habit then you will loose 23 calories.
Lyra Health

- Raised $35M, founded by Facebook CFO
- Surveys, provider matching, human care coord.
- Targeted towards large employers
Utilizing a Personal Smartphone Custom App to Assess the Patient Health Questionnaire-9 (PHQ-9) Depressive Symptoms in Patients With Major Depressive Disorder

John Torous, MD; Patrick Staples, MS; Meighan Sharahan, RN; Charlie Lin, MS; Pamela Peck, PsyD; Mattcheri Venkatar, MD; Jukka-Pekka Onnela, PhD

1Harvard Longwood Psychiatry Residency Training Program, Boston, MA, United States
2Beth Israel Deaconess Medical Center, Department of Psychiatry, Boston, MA, United States
3Department of Biostatistics, Harvard School of Public Health, Harvard Medical School, Boston, MA, United States
4Pocket B Cristiano, Palo Alto, CA, United States

We found patients report symptoms of depression differently to an app than clinicians mental.jmir.org/2015/1/e8/

BlackboxPhD @BlackBoxPhD
Can smartphones be used to predict depression? ow.ly/Omon/

ABSTRACT

Assessment of patient symptoms is critical for diagnosis and therapeutic management of mood disorders. The field of online depression care diagnostics and research holds promise, but there is a critical need to improve the assessment and interpretation of self-reported emotional symptoms on smartphones.
The “Triple Aim” of Health Reform

**Population Health**
Collection of health data enables big-data analytics

**Experience of Care**
Empowered, engaged, informed patients have better experiences

**Per-Capita Cost**
Reduction in person visits and earlier interventions bend the cost curve
Apple CareKit
CareKit is a framework to build apps that empower people to take an active role in their care.
CareKit has four ‘Modules’

- CareCard
- Symptom and Measurement Tracker
- Insight Dashboard
- Connect
Care Card

- Manage Tasks
- Medications
- Changing Wound
- Meditation
- Nutrition

- iOS 10 will have HL7 CCD
Symptom & Measurement Tracker

- Manage Tx Plan
- Symptom Scales
- Objective Measures
  - PHQ-9
Insight Dashboard

- Treatment Progress Charts
- Text Reminders
- Goal Tracking
Connect

- Communicate Health Status
- Care Providers
- Family and Friends
These are the early days

- This is a snapshot
- Think creatively
- The future is wide open
Any Questions?

Jeremy Nelson - jeremy@afiahealth.com